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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/366,850	08/04/1999	ROBERT J. FALSTER	98-0410(2489)	3575

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SENNIGER POWERS LEAVITT AND ROEDEL
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EXAMINER

KANG, DONGHEE

ART UNIT PAPER NUMBER

2811

DATE MAILED: 10/23/2002

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

09/366,850

Applicant(s)

FALSTER, ROBERT J.

Examiner

Donghee Kang

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 22 July 2002.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-34 is/are pending in the application.
- 4a) Of the above claim(s) 23-34 is/are withdrawn from consideration.
- 5) ☒ Claim(s) 13-22 is/are allowed.
- 6) ☒ Claim(s) 1-22 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on _____ is: a) ☐ approved b) ☐ disapproved by the Examiner.
- If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____.
- 4) ☐ Interview Summary (PTO-413) Paper No(s). _____.
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: _____.

DETAILED ACTION

Remarks

1. Applicant's request for reconsideration of the finality of the rejection of the last Office action is persuasive and, therefore, the finality of that action is withdrawn.

Double Patenting

2. Claims **1-3 & 8-12** are rejected under the judicially created doctrine of obviousness-type double patenting as being unpatentable over claims 1-11 of U.S. Patent No. 5,994,761. Although the conflicting claims are not identical, they are not patentably distinct from each other because the present claimed invention is broader recitation of the above mentioned patent. For instance, claim 1 of the present claimed invention is a broader of claim 1 of the '761 patent. Although claim 1 of present claimed invention does not use the phrase "crystal lattice vacancies concentration", the phrase "the concentration of the centers" as recited in claim 1 of this application would have the same meaning as the phrase "crystal lattice vacancies concentration" because the platinum concentration profile of U.S. Patent No. 5,994,761 corresponding to the vacancy concentration profile. Dependent claims 2-3, 8-11, & 12 are identical to claims 8-9, 2-6, & 11 of the '761, respectfully.

Thus, in respect to above discussions, it would have been obvious to an artisan of ordinary skill in the art at the time the invention was made to use the teachings of claims 1 of U.S. Patent No. 5,994,761 as a general teachings for a single crystalline silicon segment to perform the same functions as claimed by present applications. The

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instant claims obviously encompass the above mentioned patent and differ only in terminology.

Claim Rejections - 35 USC § 102

3. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

4. Claims **1, 4 & 6-7** are rejected under 35 U.S.C. 102(b) as being anticipated by Gamo et al. (US 3,860,947).

Regarding claim **1**, Gamo discloses a single crystal silicon segment having two major, generally parallel surface, one of which is the front surface of the segment and the other of which is the back surface of the segment, a central plane between the front and back surface, a circumferential edge joining the front and back surface, a surface layer which comprises a region of the segment below the front surface and a distance as measured from the front surface and toward the central plane and the first region, the segment being characteristic in that

the segment has a non-uniform distribution of minority carrier recombination centers, with the concentration of the centers in the bulk layer being greater than the concentration in the surface layer and with the centers having a concentration profile in which the peak density of the centers is at or near the central plane with the concentration generally decreasing from the position of peak density in the direction of the front surface of the segment.

Regarding claim 4, Gamo discloses the thickness is selected to be from several ten to several hundred microns which is in the claimed ranges (Col.2, lines 63-65).

Regarding claims 6-7, Gamo discloses the concentration of minority carrier recombination centers in the surface layer is less than about 1×10^{16} atoms/cm³. See Fig.3.

Claim Rejections - 35 USC § 103

5. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

6. Claims 5 & 8-12 are rejected under 35 U.S.C. 103(a) as being unpatentable over Gamo et al. (US 3,860,947).

Regarding claim 5, Gamo teaches a thickness is selected to be from several ten to several hundred microns as measured in the direction normal to the surface 12 and 14.

Although Gamo does not teach the thickness is in a range from about 800 microns to about 1200 microns, it is an obvious matter of routine experimentation to find the optimal thickness range. Generally, differences in thickness of the various layers will not support the patentability of subject matter encompassed by the prior art. "Where the general conditions of a claim are disclosed in the prior art, it is not inventive to discover the optimum or workable ranges by routine experimentation."

Regarding claims **8-11**, Gamo's device has a distance as measured from the front surface and toward the central plane. Gamo, however, does not explicitly teach the distance is at least 10, 30, 50, or 100 microns. It would have been obvious to one of ordinary skill in the art at the time the invention was made to select a distance of various layers in device, since it has held that where the general conditions of a claim are disclosed in the prior art, discovering the optimum or workable ranges involves only routine skills in the art. In re Aller, 105 USPQ 233.

7. Claims **2-3** are rejected under 35 U.S.C. 103(a) as being unpatentable over Gamo in view of Eaglesham (US 5,731,626).

Gamo teaches substantially the entire claimed structure, as applied to claim 1 above, except that the silicon segment having a carbon concentration which is less than 1×10^{16} or 5×10^{15} atoms/cm³. However, Eaglesham teaches the presence of substitutional carbon within such as silicon layer has been demonstrated to be an effective means of controlling the diffusion (Col.3, lines 54-58). Eaglesham notes that preferably, substitutional carbon is incorporated in the silicon layer at a level expressed in terms of concentration, which is less than about 1×10^{20} C/cm³. Therefore, it would have been obvious in the art at the time the invention was made to incorporate the teaching of Eaglesham into the Gamo's device, since the diffusion of ion-implanted dopant atoms, e.g., boron, phosphorous, etc., in a deposited semiconductor layer is controlled by the process which comprises incorporating a diffusion-suppressing

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amount of an electrically inactive impurity in the semiconductor layer by a crystal growth technique.

8. Claim **12** is rejected under 35 U.S.C. 103(a) as being unpatentable over Gamo in view of Allman (US 5,645,736).

Gamo teaches substantially the entire claimed structure, as applied to claim 1 above, except that the front surface is polished. It is conventional to polish the surface of silicon wafer in the art and also taught by Allamn (see abstract). Thus, it would have been obvious in the art at the time the invention was made to polish the surface of silicon wafer in order to planarize the silicon wafer.

9. Claims **1 & 4-11** are rejected under 35 U.S.C. 103(a) as being unpatentable over Temple ("Opimizing Carrier Life Profile for improved Trade-off Between Turn-off Time and Forward Drop", IEEE Electron Deivce, July 19, 1983) in view of Gamo et al. (US 3,860,947).

Regarding claim **1**, Temple teaches a thyristor structure having two major, generally parallel surface, one of which is the front surface of the segment and the other of which is the back surface of the segment, a central plane between the front and back surface, a circumferential edge joining the front and back surface, a surface layer which comprises a first region of the segment below the front surface and a distance as measured from the front surface and toward the central plane, and a bulk layer which

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comprises a second region of the segment between the central plane and the first region, the segment being characterized in that

the segment has a non-uniform distribution of minority carrier recombination centers, with the concentration of the centers in the bulk layer being greater than the concentration in the surface layer and with the centers having a concentration profiles in which the peak density of the centers is at or near the central plane with the concentration generally decreasing from the position of peak density in the direction of the front surface of the segment (See Fig.4).

Temple does not explicitly teach thyristor device comprising a single silicon segment. However, Gamo teaches wafer is prepared from a silicon monocrystal material (Col. 1, lines 23-25 & Col.2, lines 58-59). Thus, it would have been obvious in the art at the time the invention was made to make thyristor using silicon segment, since silicon material is cheap and most well known semiconductor material.

Furthermore, it would have been obvious to one having ordinary skill in the art at the time the invention was made to fabricate thyristor device, *having the materials as claimed*, since it has been held to be within the general skill of a worker in the art to select a known material on the basis of its suitability for the intended use as a matter of obvious design choice. *In re Leshin*, 125 USPQ 416.

Regarding claims 4-5, Temple does not explicitly teach the segment having a thickness ranging from about 500 microns to about 800 microns or from about 800 microns to about 1200 microns. Gamo teaches the thickness of segment is selected to be from several ten to several hundred microns which is in the claimed ranges (Col.2,

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lines 63-65). Although neither Temple nor Gamo teaches the thickness is in a range from about 800 microns to about 1200 microns, it is an obvious matter of routine experimentation to find the optimal thickness range. Generally, differences in thickness of the various layers will not support the patentability of subject matter encompassed by the prior art. "Where the general conditions of a claim are disclosed in the prior art, it is not inventive to discover the optimum or workable ranges by routine experimentation."

Regarding claims 6-7, Temple does not teach the concentration of minority carrier recombination centers in the surface layer. Gamo teaches the concentration of minority carrier recombination centers in the surface layer is less than about 1×10^{16} atoms/cm³ (See Fig.3). It is within the ordinary skill of one in the art to find the optimal range of the concentration of minority carrier through obvious and routine experimentation.

Regarding claims 8-11, Temple and Gamo's device has a distance as measured from the front surface and toward the central plane. Neither Tempel nor Gamo, however, explicitly teach the distance is at least 10, 30, 50, or 100 microns. It would have been obvious to one of ordinary skill in the art at the time the invention was made to select a distance of various layers in device, since it has held that where the general conditions of a claim are disclosed in the prior art, discovering the optimum or workable ranges involves only routine skills in the art. In re Aller, 105 USPQ 233.

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10. Claims **2-3** are rejected under 35 U.S.C. 103(a) as being unpatentable over Temple in view of Gamo, as applied to claim 1 above, and further in view of Eaglesham et al. (US 5,731,626).

Temple as modified by Gamo teaches substantially the entire claimed structure except that the silicon segment having a carbon concentration which is less than 1×10^{16} or 5×10^{15} atoms/cm³. However, Eaglesham teaches the presence of substitutional carbon within such as silicon layer has been demonstrated to be an effective means of controlling the diffusion (Col.3, lines 54-58). Thus, it would have been obvious in the art for the same reason as given in the section 7 (see above).

11. Claim **12** is rejected under 35 U.S.C. 103(a) as being unpatentable over Temple in view of Gamo, as applied to claim 1 above, and further in view of Allman (US 5,645,736).

Neither Temple nor Gamo teaches the front surface is polished. It is conventional to polish the surface of silicon wafer in the art and also taught by Allman (see abstract). Thus, it would have been obvious in the art at the time the invention was made to polish the surface of silicon wafer in order to planarize the silicon wafer.

Allowable Subject Matter

12. Claims **13-22** are allowed.

13. The following is an examiner's statement of reasons for allowance:

Prior art of record neither teaches nor makes it obvious as a whole the claimed limitation of the instant application, as recited in claim 13, either taken alone or in

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combination. In particular, prior art fails to anticipate or render obvious the claimed structure especially the limitations of "a maximum concentration of the recombination centers being in a region which is between the front surface and the central plane and nearer to the front surface than the central surface".

Any comments considered necessary by applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably accompany the issue fee. Such submissions should be clearly labeled "Comments on Statement of Reasons for Allowance."

Conclusion

14. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

Jaecklin et al. (US 3,943,549).

15. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Donghee Kang whose telephone number is 703-305-9147. The examiner can normally be reached on Monday through Friday.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Tom Thomas can be reached on 703-308-2772. The fax phone numbers for the organization where this application or proceeding is assigned are 703-308-7722 for regular communications and 703-308-7722 for After Final communications.

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Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703-308-0956.

DHK
October 18, 2002

Steven Loh